Lab 1 was just to familiarize yourself with basic Matlab commands and constructs and to work through the first section of the `matlab.txt` handout.

This lab concerns the use of Matlab to generate and analyze piecewise linear signal functions and sinusoids.

1. Get copies of the two functions: unit-step, \( u(t) \), (Matlab `ustep.m`) and ramp, \( r(t) \), (Matlab `ramp.m`). Graph the piecewise linear function

\[
x(t) = -2r(t + 4) + 3r(t + 2) + 2u(t) - r(t - 3)
\]

for \(-5 \leq t \leq 5\).

2. Find a linear combination of translates of the ramp and unit-step functions which yields the continuous piecewise linear function \( x(t) \) which is zero outside of \([-4, 4]\), and which takes the values: \( x(-4) = 0, x(-1) = 3, x(0) = 3, x(1) = 1, \) and \( x(2) = 1, x(3) = 0, \) and \( x(4) = 0 \). Do you actually need to use the unit-step function? Why or why not?

Check your answer by plotting it in Matlab.

3. Consider the sinusoid

\[
x(t) = 1.5 \cos(2\pi t - \pi/2)
\]

What is the amplitude, frequency (in radians/sec), and phase angle? Graph this sinusoid in Matlab (you may want to expand the size of the graph and add a grid). Why is \( x(0) = 0 \)? Write \( x(t) \) in terms of a sine function (instead of a cosine function).

4. Consider two sinusoids

\[
x_1(t) = \cos(\Omega_1 t + \phi_1) \quad \text{and} \quad x_2(t) = \cos(\Omega_2 t + \phi_2)
\]

What is the period of \( x_1(t) \); what is the period of \( x_2(t) \)? Suppose that \( \Omega_1 / \Omega_2 \) is a rational number (i.e. of the form \( m/n \) for \( m, n \in \mathbb{N} \)). Show that \( x_1(t) + x_2(t) \) is periodic. Hint: if \( \Omega_1 / \Omega_2 = m/n \) then

\[
\frac{2\pi m}{\Omega_1} = \frac{2\pi n}{\Omega_2}
\]

Assignment. Consider the square wave \( s(t) \) defined as follows:

\[
s(t) = 1 \quad \text{if} \quad m \leq t < (m + 1) \quad \text{if} \quad m \text{ is even}
\]

\[
s(t) = -1 \quad \text{if} \quad m \leq t < (m + 1) \quad \text{if} \quad m \text{ is odd}
\]

Clearly, \( s(t) \) is defined for all real numbers.

1. find a formula for \( s(t) \) in terms of the unit-step \( u(t) \) and ramp \( r(t) \) functions valid on any finite interval \([m, n]\) having integer endpoints (i.e. \( m, n \in \mathbb{Z} \)).

2. can you find a formula for \( s(t) \) valid for all real numbers? Why or why not? You are allowed to use infinitely many terms, if necessary, as long as the sum is locally finite.

Email your answers to me as an inline ascii text file. Please do not e-mail attachments to me. I will just send them back. It is completely unnecessary and wasteful of both network bandwidth and spooling space to send attachments which are just text.